United States Environmental Protection Agency
Office of Solid Waste and Emergency Response
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December 1985

Report To Congress

Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale

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December 31, 1985

U.S. Environmental Protection Agency

Office of Solid Waste

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

DEC 31, 1985

THE ADMINISTRATOR

Honorable George Bush
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

I am pleased to transmit the Report to Congress on "Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale" presenting the results of studies carried out pursuant to Sections 8002 (f) and (p) of the Resource Conservation and Recovery Act of 1976, as amended, (42 U.S.C. SS6982 (f) and (p)).

The Report provides a comprehensive assessment of possible adverse effects on human health and the environment from the disposal and utilization of solid waste from the extraction and beneficiation of ores and minerals. All metal, phosphate, and asbestos mining segments of the United States mining industry are included in the assessment. Waste categories covered include mine waste, mill tailings, and waste from heap and dump leaching operations.

The Report and appendices are transmitted in one volume.

Sincerely yours,

Lee M. Thomas

Enclosures

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

DEC 31, 1985

THE ADMINISTRATOR

Honorable Thomas P. O'Neill
Speaker of the House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

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EXECUTIVE SUMMARY

This is the executive summary for the Environmental Protection Agency's Report to Congress on Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale. EPA has prepared this report in response to the requirements of Sections 8002(f) and (p) of the Resource Conservation and Recovery Act (RCRA). Section 8002(f), a part of RCRA when it was originally enacted in 1976, directed EPA to perform a

> detailed and comprehensive study on the adverse effects of solid wastes from active and abandoned surface and underground mines on the environment, including, but not limited to, the effects of such wastes on humans, water, air, health, welfare, and natural resources ....

Section 8002(p), which Congress added to RCRA when it amended the Act in 1980, required EPA to conduct a

> detailed and comprehensive study on the adverse effects on human health and the environment, if any, of the disposal and utilization of solid wastes from the extraction, beneficiation, and processing of ores and minerals .... Such study shall be conducted in conjunction with the study of mining wastes required by subsection (f) ....

Under the 1980 amendments, EPA is prohibited from regulating solid waste from the "extraction, beneficiation, and processing of ores and minerals" under Subtitle C of RCRA until at least 6 months after the Agency completes these studies and submits them to Congress. The purpose of this prohibition is to exempt these wastes temporarily from the requirements of the RCRA hazardous waste management system. After submitting the required studies, holding public hearings, and providing the public with an opportunity to comment, the Administrator must "determine to promulgate regulations" or "determine such regulations are unwarranted" for these mining wastes.

If EPA decides to regulate mining wastes as hazardous under RCRA Section 3004(x), which Congress added to the Act as part of the Hazardous and Solid Waste Amendments of 1984, EPA may modify provisions of these regulations pertaining to liquids in landfills, land disposal restrictions, and minimum technology requirements, as they apply to mining wastes. In doing so, EPA may

> take into account the special characteristics of such wastes, the practical difficulties associated with implementation of such requirements, and site-specific characteristics, including, but not limited to, the climate, geology, hydrology and soil chemistry at the site, so long as such modified requirements assure protection of human health and the environment.

This report addresses wastes from the extraction and beneficiation of metallic ores (with special emphasis on copper, gold, iron, lead, silver, and zinc), uranium overburden, and the nonmetals asbestos and phosphate rock. The Environmental Protection Agency's findings on oil shales are summarized in Appendix A of this report. EPA selected these mining industry segments because they generate large quantities of wastes that are potentially hazardous and because the Agency is solely responsible for regulating the waste from extraction and beneficiation of these ores and minerals. Likewise, the Agency excluded from the study wastes generated by the clay, sand and gravel, and stone mining segments, since it judged wastes from these sources less likely to pose hazards than wastes from the industries included. EPA also excluded uranium mill tailings wastes, because the Agency has already submitted a report to Congress on uranium mill tailings. The Agency excluded wastes from coal mining and beneficiation, because both EPA and the Department of the Interior play a role in their regulation, and it is not clear whether Congress intended coal mining to be included within the scope of the studies conducted in response to Sections 8002(f) and (p) of RCRA. Finally, EPA excluded large-volume processing wastes. On October 2, 1985, EPA proposed to reinterpret the scope of the mining waste exclusion as it applies to processing wastes, leaving only large volume processing wastes excluded (FR 401292). Other wastes from processing ores and minerals that are hazardous would be brought under full Subtitle C regulation after promulgation of the reinterpretation, and would therefore not be included in the scope of a subsequent Report to Congress on processing wastes. The large-volume processing wastes that remain within the exclusion would be studied and a Report to Congress prepared to complete EPA's response to the RCRA Section 8002 (p) mandate.

The remainder of this Executive Summary consists of five sections. First, we provide an overview of the industry segments covered in this report. Next, we describe management practices for mining wastes. Then we discuss the potential danger to human health and the environment that mining wastes pose. Following this, we estimate the costs that regulating mining wastes could impose under several scenarios and briefly outline the effects of these costs on product prices. Finally, we present the Agency's conclusions and recommendations.

OVERVIEW OF THE NONFUEL MINING INDUSTRY

The nonfuel[1] mining industry is an integral part of our economy, providing a wide range of important products. The value of raw nonfuel

1 For the purposes of this report, the nonfuel mining industry is defined to include uranium, although processed uranium may be used as a fuel.

minerals is about 1 percent of the Gross National Product (GNP), and products made from these raw materials account for about 9 percent of the GNP.

The number of active mines varies from year to year, depending on economic factors; in 1980 (the most recent year for which complete data are available from the U.S. Bureau of Mines), there were about 600 metal mines and about 12,000 nonmetal mines. Most of the nonmetal mines were clay, sand and gravel, and stone mines, and thus fall outside the scope of this report. In the industry segments that this report covers, a few large mines generally produce most of the ore and generate most of the waste.

Ores occur only in certain geologic formations, so much of the mining within an industry segment is concentrated in a few locations. Because the raw ore must be extracted from the earth, and only a small percentage of the mined rock is valuable, vast quantities of material must be handled for each unit of marketable product. Much of this material is waste.

Mine waste is the soil or rock that is generated during the process of gaining access to the ore or mineral body. Tailings are the wastes generated by several physical and chemical beneficiation processes that may be used to separate the valuable metal or mineral from the interbedded rock; the choice of process depends on the composition and properties of the ore and of the gangue, the rock in which the ore occurs. Some low-grade ore, waste rock, and tailings are used in dump or heap leaching, a process that the mining industry considers a form of beneficiation and one that involves spraying the material with acid or cyanide to leach out metals. This process is most widely practiced in the copper, silver, and gold mining segments, and the associated wastes are termed dump/heap leaching wastes. The final waste type is mine water, water that infiltrates the mine during the extraction process. Table ES-1 lists the types and quantities of mining wastes generated by each mining segment of concern.

Extraction and beneficiation produce large quantities of waste. The segments covered in this report generate 1 to 2 billion tons of waste each year and have so far produced over 50 billion tons of waste. Copper, iron ore, uranium, and phosphate mining operations are responsible for more than 85 percent of this total volume of waste and continue to account for most of the waste presently generated. As lower and lower grades of ore are mined, more waste per unit of product is generated.

Approximately one-half of the waste generated by the segments of concern is mine waste, and one-third is tailings. Most of the mine waste is from phosphate, copper, iron ore, and uranium mining; the majority of tailings are from the copper, phosphate, and iron ore segments. Only the copper, gold, and silver mining industries presently generate dump or heap leach waste. The following section discusses how industry currently manages these wastes.

WASTE MANAGEMENT PRACTICES

Mine waste, tailings, heap and dump leach wastes, and mine water can be managed in a variety of ways. Figure ES-1 provides an overview of waste management practices. Waste management practices include recovery operations, volume reduction, treatment, onsite and offsite use, and waste siting and disposal. For mine waste and tailings, disposal constitutes the major practice; about 56 percent of mine wastes are currently managed by disposal in piles, and about 61 percent of tailings are managed in tailings ponds. About 30 percent of mine waste and tailings are used on site in leaching operations,

Table ES-1 Waste Generation
(Millions of Metric Tons in 1982)

Mining industry segment	Mine waste	Tailings	Leaching wastes	Total
Metals:				
Copper	124	178	200 (dump)	502
Gold	39	24	11 (heap)	74
Iron	102	75	-	177
Lead	2	9	-	11
Molybdenum	24	6	-	30
Silver	20	6	<1 (heap)	26
Uranium	73	NA	-	73
Zinc	1	6	-	7
Other metals	23	3	-	26
Subtotal	408	307	211	926
Nonmetals:				
Asbestos	4	2	-	6
Phosphate	294	109	-	403
Subtotal	298	111	-	409
TOTAL	706	418	211	1,335

Source: Estimated by Charles River Associates 1985 based on BOM 1983.

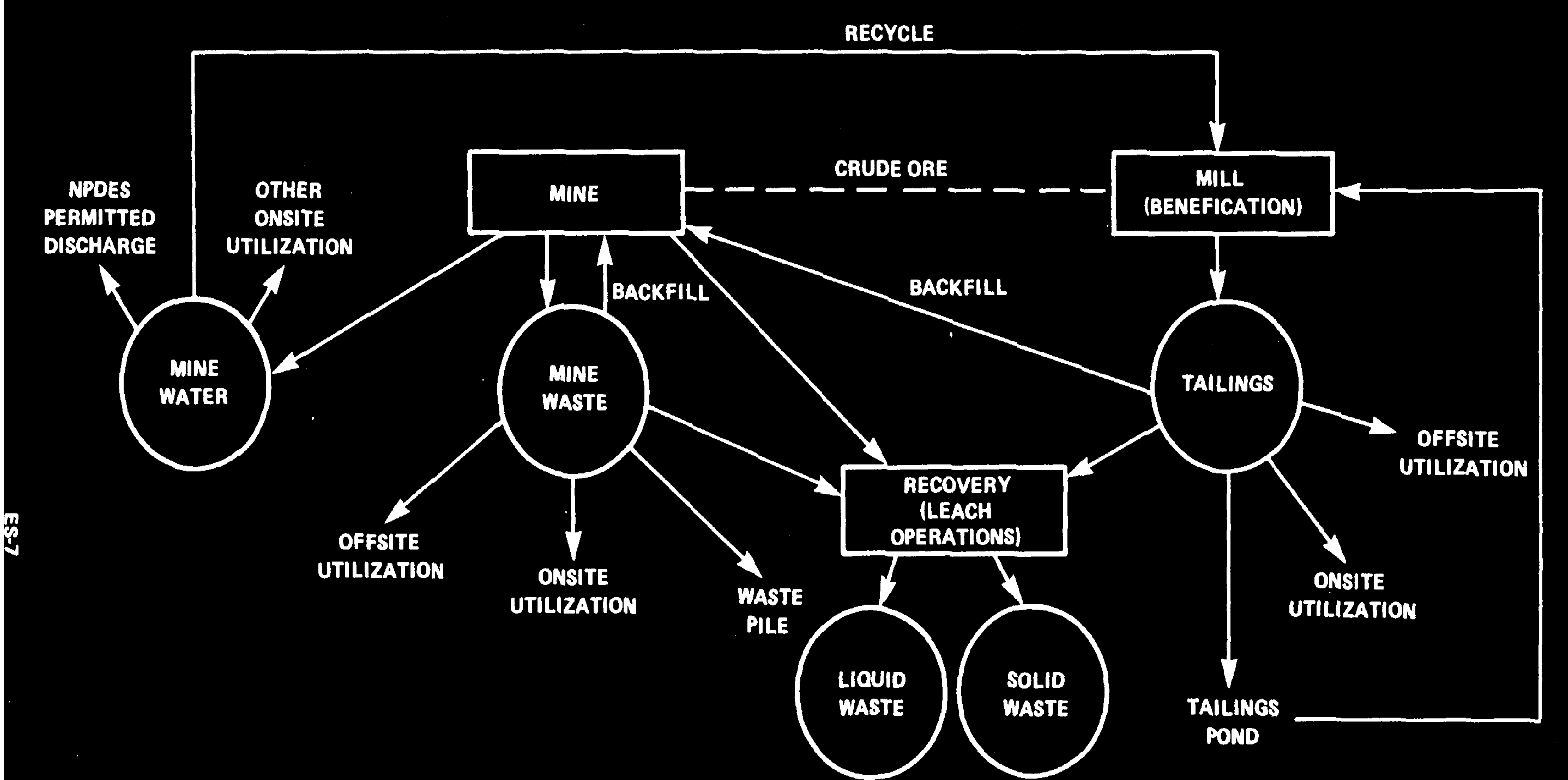

Figure ES-1 The mining waste management process construction of tailings impoundments, and road construction. Present disposal and utilization practices for all metal and nonmetal industry segments are presented in Table ES-2. A discussion of waste management practices follows.

Several methods are available to treat, change, or reduce wastes before disposing of them. In operations using cyanide, it may be possible to oxidize the cyanide before disposal. It may also be possible to remove pyrites from tailings, thus reducing, although not eliminating, their potential for forming acid. Finally, water can be removed from tailings, creating a thickened discharge.

Extraction and milling wastes can also be used off site; the most common use of these wastes is in road construction. Researchers are investigating other uses for both mine wastes and tailings, such as use in soil supplements, in wallboard and brick/block products, and in ceramic products. However, it is unlikely that use of mining wastes will increase greatly in the future, because in most cases their commercial potential is not sufficient to overcome the economic disadvantages, such as high transportation costs, associated with their use.

Mine water can also be used on site in the milling process as makeup water or for dust control, cooling, or drilling fluids. In most cases, however, the amount of mine water exceeds the quantity that can be used.

The majority of the solid waste generated in mining is not reduced by any of the methods described above and must be disposed of. Siting disposal facilities in appropriate locations is fundamental to environmental protection, and other management methods are available for ameliorating waste disposal problems.

Table ES-2 Present Mining Waste Disposal and Utilization Practices (Millions of Metric Tons/Year)

Practice	Waste type and volume	
	Mine waste	Mill tailings
Pile	569	-
Backfill	86	21
Onsite utilization	313	141
Impoundments	-	267
Offsite utilization	43	8
TOTAL	1,011	437

During active site life, during closure, and in the post-closure period, facilities could employ engineering controls to prevent erosion, to keep leachate out of the ground water, or to remove contaminants introduced into ground water. However, EPA data on management methods at mining facilities indicate that only a small percentage of mines currently monitor their ground water, use run-on/runoff controls or liners, or employ leachate collection, detection, and removal systems. EPA has not determined the circumstances under which these waste measures would be appropriate at mine waste and mill tailing disposal sites.

POTENTIAL DANGER TO HUMAN HEALTH AND THE ENVIRONMENT

The potential dangers posed by wastes from nonfuel mining and beneficiation vary greatly and depend on the industry segment; the beneficiation process; and site-specific geologic, hydrologic, and climatic factors. Some rock is naturally high in metals or radionuclides. Some beneficiation processes use acids and cyanides. Mine waste, tailings, and mine water can contain these materials and also be acidic or alkaline. Hazardous substances could leak into the environment, polluting the soil and surface and ground water and endangering receptor populations.

The Agency has not yet performed a quantitative risk assessment. Risk analysis can provide a quantitative estimate and allow EPA to distinguish between the risk posed by current, past, and alternative management practices. Additionally, it will enable the Agency to evaluate how site-specific factors such as hydrology, proximity to surface water, climate, distance from human populations, type and sensitivity of aquatic populations, closeness to drinking water supplies, and the chemical and physical composition of the waste itself affect risk.

EPA evaluated the potential dangers posed by mining wastes by testing for the RCRA characteristics of corrosivity and EP toxicity and by assessing the level of several other substances in these wastes. A substance was considered corrosive if the pH was equal to or less than 2 (acidic) or equal to or greater than 12.5 (alkaline). A substance was determined to be EP toxic if, using a specified leaching procedure, it exceeded the National Interim Primary Drinking Water Standards (NIPDWS) for an EP toxic metal by a factor of 100.

Only samples from copper dump leach met the RCRA characteristic for corrosivity because of low pH, but pH values were quite low (more than 2 and less than or equal to 4) for many samples from the copper and other metals industry segments and for one sample from the molybdenum segment. Only one sample, from the "other" metals industry segment, met the RCRA characteristic for corrosivity because of high pH. In addition, one sample each from the gold and silver industry segments, three from the copper industry segment, and four from the other metals segment had relatively high (more than 10 and less than or equal to 12.5) pH values. EP toxic results were obtained for at least one sample from copper dump/heap leachate, gold tailings and mine waste, lead mine waste and tailings, silver tailings and mine waste, and zinc tailings. EPA's water quality criteria for the protection of aquatic life are generally set at levels at lower concentrations than those established by the NIPDWS.

Another potential threat to organisms and the environment is acid formation. Wastes with the highest acid formation potential are in the copper, gold, and silver industry segments, although the degree of potential harm varies with the mineral content of wastes and soils (some wastes and soils have neutralizing chemicals), amount of precipitation (more increases the potential for acid drainage), and other factors not evaluated.

Of the other potentially hazardous constituents considered, cyanide was detected in copper and gold tailings ponds and gold heap leachate. Radioactive material was found in uranium and phosphate mine waste samples and in phosphate tailings. Although only asbestos mining wastes were tested in this study for asbestos content, effluent guideline data suggest that asbestos may be present in wastes generated by some metal mining industry segments. EPA has insufficient data to evaluate the hazard, if any, posed by asbestos contained in metal mining wastes.

Based on these sampling results, EPA estimates that the copper mining segment generates 50 million metric tons of RCRA corrosive waste annually. The gold, lead, silver, and zinc industry segments generate a total of 11.2 million metric tons of RCRA EP toxic waste annually. EPA estimates that 182 million metric tons of copper dump leach are generated annually, and that the gold and silver segments generate a total of 9.3 million metric tons of tailings and 14 million metric tons of heap leach annually. High acid formation potential waste is estimated at 95 million metric tons a year. The phosphate and uranium mining industries generate approximately 443 million metric tons of radioactive waste (with a radioactivity level of more than 5 picocuries/gram, the level established as a "cleanup" standard under the 1983 standards for Protection Against Uranium Mill Tailings). There are also 5 million metric tons of asbestos-containing waste (asbestos content greater than 1 percent by weight) generated each year. Estimated amounts of potentially hazardous wastes are reported in Table ES-3.

Of the estimated 1,340 million metric tons of waste generated annually by metal, asbestos, and phosphate mining, 61 million tons are estimated to be hazardous under current RCRA Subtitle C characteristics. Adding wastes with

Table ES-3 Estimated Amounts of Wastes with RCRA Hazardous Characteristics and Other Wastes Potentially Subject to Regulation as Hazardous Wastes Under RCRA

Category	Annual amount (millions of metric tons)	Source	Potential danger
<u>RCRA Characteristics</u>			
Corrosive	50	Copper 1 each dump liquor	Ground-water acidification
EP toxic	11	Gold, silver, lead, zinc wastes	Toxic metal ground-water contamination
<u>Other Categories</u>			
Precious metal recovery wastes	9	Gold, silver	Cyanide contamination of surface and ground water
Heap leaching wastes	14[a]	Gold, silver	Cyanide contamination of surface and ground water
Dump leaching waste	182[a]	Copper dump leach wastes	Massive release of toxic metals and low pH liquids
Radioactive wastes (5 pCi/g)	352 91	Phosphate, uranium	Radon emissions
Acid formation	95	Copper mill tailings	Release of low pH liquids after closure
Asbestos	5	Asbestos mines and mills	Cancer
	755[a]		

a The total annual amount of waste is not equal to the sum of hazardous waste in each category because some wastes are in more than one category. For example, 50 million metric tons of copper dump leach waste are also corrosive, and 4 million metric tons of gold tailings are both EP toxic and contaminated with cyanide.

high acid formation potential, those that contain asbestos, those that are potential candidates for listing because they commonly have high levels of cyanide (greater than or equal to 10 mg/1), and radioactive wastes (radium-226 greater than or equal to 5 picocuries/gram) would increase this total to 755 million metric tons of potentially hazardous waste generated by these mining industry segments each year.

EPA conducted a study to determine whether mining waste management facilities leak and, if they do, whether they release constituents that are of concern. Surface water and/or ground water was monitored at eight representative active mine sites. Results indicate that constituents from impoundments do enter ground water at most sites, but significant increases in the concentrations of hazardous constituents were rarely demonstrated.

Damage cases, however, show that mine runoff and seepage have adversely affected surface and ground water in several mining districts. Sudden and chronic releases of cyanides, acids, and metals have reduced fish populations and the number of other freshwater organisms. However, some of these incidents were caused by waste management practices that are no longer in use.

THE ECONOMIC COST OF POTENTIAL RCRA WASTE MANAGEMENT

EPA examined the wide range of potential costs that regulating mining wastes as hazardous under RCRA could impose on facilities and segments of the mining industry. To examine this range, EPA estimated the incremental costs, those over and above the costs the industry already incurs to manage wastes, for eight regulatory scenarios of varying stringency. EPA constructed these eight scenarios by taking all combinations of four different sets of management standards and two criteria for determining whether wastes are hazardous.

The estimation procedure applied specific information from 47 mines to develop costs at these mines and then extrapolated these results to the universe covered in this report.

The management standards that EPA examined ranged from imposing the full set of RCRA Subtitle C regulations (the most expensive set of management standards, Scenario 1) to requiring only a limited set of requirements: permits, a leachate collection system, a ground-water monitoring system, a run-on/runoff system, and post-closure maintenance (Scenario 4). Under the first criterion for determining whether wastes were hazardous, waste streams failing the Subtitle C characteristics tests for EP toxicity and corrosivity and cyanide wastes from gold metal recovery operations were included as hazardous (Scenario A). Under the second criterion, all wastes captured under the first set were included, as well as (1) wastes from gold and silver heap leach operations, (2) wastes with high acid formation potential, and (3) copper dump leach wastes (Scenario B) . Both hazardous waste criteria captured only wastes from the copper, gold, silver, lead, and zinc mining segments.

Estimated costs could be very substantial, depending on the management standards and criteria for defining hazardous waste. Under the most costly combination (the unlikely scenario imposing the full set of RCRA regulations and the most restrictive criterion for determining whether waste is hazardous, Scenario 1B), the annualized costs for the mining segments covered by the assessment were $850 million per year, while for the least costly combination (maintenance and monitoring), the annualized cost was $7 million per year. (Annualized costs resemble mortgage payments, in that they spread the present value of total costs into equal payments over the time period EPA estimates the affected mines will be productive.)

As the previous paragraph demonstrates, costs vary substantially across the different cost scenarios. Generally, the highest cost scenarios are several times more expensive than the intermediate cost scenarios; these, in turn, are several times more expensive than the least expensive. The additional waste management costs incurred by adding Scenario B wastes to the wastes to be regulated are also substantial; the costs of managing all Scenario B wastes would be two to four times higher than the costs of managing only the Scenario A wastes, for any given management standard.

The potential costs of regulation also vary widely for the five individual metal mining segments, both across segments and scenarios. Under all scenarios, the copper industry would incur the largest cost, while the gold industry would bear the second highest lifetime cost.

The additional effects of regulation on some segments of the mining industry could be substantial. For a low-cost scenario, average affected facilities in the zinc segment (the segment most affected by regulatory costs as a percent of direct product cost) would incur costs as high as 5 percent of direct product costs, while under a high-cost scenario a zinc facility could incur costs of 10 percent. Under a high-cost scenario, RCRA compliance costs as a percent of direct product cost for the average affected facility were 21 percent in the lead industry and ranged upward of 120 percent in the copper industry.

CONCLUSIONS

Structure and Location of Mines

EPA focused on segments producing and concentrating metallic ores, phosphate rock, and asbestos, totalling fewer than 500 active sites during 1985. These sites are predominantly in sparsely populated areas west of the

Mississippi but have great diversity in size, product value, and volumes of material handled. Several segments are concentrated primarily in one state: the iron segment is mainly concentrated in Minnesota, lead in Missouri, copper in Arizona, asbestos in California, and phosphate in Florida.

Waste Quantities

Aggregate waste quantities generated were 1.3 and 2 billion metric tons per year in 1982 and 1980, respectively. The accumulated waste (for segments other than coal) is estimated to be approximately 50 billion metric tons. Waste-to-product ratios are generally higher in mining industry segments than in other industrial segments. Some individual mines and mills handle more materials than many entire industries, but 25 percent of the mines studied handled less than 1,000 metric tons per year.

Potential Hazard Characteristics

Of the 1.3 billion metric tons of wastes that EPA estimates will be generated by extraction and beneficiation in 1985, about 61 million metric tons (5 percent) exhibit the characteristics of corrosivity and EP (extraction procedure) toxicity. Another 23 million metric tons (2 percent) are beneficiation wastes contaminated with cyanide. Also, there are 182 million metric tons (14 percent) of copper leach dump material and 95 million metric tons (7 percent) of copper mill tailings with the potential for release of acidic and toxic liquids. If waste with radioactivity content greater than 5 picocuries per gram is considered hazardous, the hazardous volume is 443 million metric tons (34 percent) from the phosphate and uranium segments; if waste with radioactivity greater than 20 picocuries per gram is considered hazardous, the total is 93 million metric tons (7 percent). Four asbestos mines generated about 5 million metric tons (less than 1 percent) of waste with a chrysotile content greater than 5 percent.

Evidence of Environmental Transport

At mine sites, ground-water monitoring is difficult and expensive, and generally is not conducted on a large scale. From short-term monitoring studies at eight sites, EPA detected seepage from tailings impoundments, a copper leach dump, and a uranium mine water pond. However, EP toxic metals of concern did not appear to have migrated during the 6- to 9-month monitoring period. Other ground-water monitoring studies have detected sulfates, cyanides, and other contaminants from mine runoff, tailings pond seepage, and leaching operations.

Evidence of Damages

Incidents of damage (contamination of drinking water aquifers, degradation of aquatic ecosystems, fish kills, and related reductions of environmental quality) have been documented in the phosphate, gold, silver, copper, lead, and uranium segments. There are 13 mining sites on the National Priorities List (Superfund), including five gold/silver, three copper, three asbestos, and two lead/zinc mines. The asbestos Superfund sites differ from other sites in that these wastes pose a hazard via airborne exposure. It is not clear, from the analysis of damage cases and Superfund sites, whether or not current waste management practices can prevent damage from seepage or sudden releases. However, it is clear that some of the problems at abandoned or Superfund sites are attributable to waste disposal practices not currently used by the mining industry.

Waste Management Practices

Site selection for the mine, as well as its associated beneficiation and waste disposal facilities, is the single most important aspect of environmental protection in the mining industry. Most mine waste is disposed of in piles, and most tailings in impoundments. Mine water is often recycled through the mill and used for other purposes on site. Offsite utilization of mine waste and mill tailings is limited (2 to 4 percent). Some management measures (e.g., source separation, treatment of acids or cyanides, and waste stabilization) now used at some facilities within a segment of the mining industry could be more widely used. Other measures applied to hazardous waste in nonmining industries may not be appropriate. Soil cover borrowed from surrounding terrain may create additional reclamation problems in arid regions.

Potential Costs of Regulation

For five metal mining segments, total annualized costs range from $7 million per year (for a scenario that emphasizes primarily basic maintenance and monitoring, for wastes that are hazardous by RCRA characteristics) to over $800 million per year (for an unlikely scenario that approximates a full RCRA Subtitle C regulatory approach, emphasizing cap and liner containment for all wastes considered hazardous under the current criteria, plus cyanide and acid formation wastes). About 60 percent of the total projected annualized cost at active facilities can be attributed to the management of waste accumulated from past production. Those segments with no hazardous wastes (e.g., iron) would incur no costs. Within a segment, incremental costs would vary greatly from facility to facility, depending on current requirements of state laws, ore grade, geography, past waste accumulation, percentage of waste with hazardous characteristics, and other factors.

RECOMMENDATIONS

Section 8002(f) of RCRA requires EPA to conduct a study of the adverse effects of mining waste and to provide "recommendations for Federal...actions concerning such effects." Based on our findings from this study, we make several preliminary recommendations for those wastes and industry segments included in the scope of the study. The recommendations are subject to change based on continuing consultations with the Department of the Interior (DOI) and new information submitted through the public hearings and comments on this report. Pursuant to the process outlined in RCRA ~3001(b)(3)(C), we will announce our specific regulatory determination within 6 months after submitting this report to Congress.

First, EPA is concerned with those wastes that have the hazardous characteristics of corrosivity or EP toxicity under current RCRA regulations. EPA intends to investigate those waste streams. During the course of this investigation, EPA will assess more rigorously the need for and nature of regulatory controls. This will require further evaluation of the human health and environmental exposures mining wastes could present. EPA will assess the risks posed by mining waste sites and alternative control options. The Agency will perform additional waste sampling and analysis, additional ground-water or surface water monitoring and analysis, and additional analysis of the feasibility and cost-effectiveness of various control technologies.

If the Agency determines through the public comments, consultation with DOI and other interested parties, and its own analysis, that a regulatory strategy is necessary, a broad range of management control options consistent with protecting human health and the environment will be considered and evaluated. Moreover, in accordance with Section 3004(x), EPA will take into account "the special characteristics of such waste, the practical difficulties associated with implementation of such requirements and site specific characteristics...," and will comply with the requirements of Executive Orders 12291 and 12498 and the Regulatory Flexibility Act.

Second, EPA will continue gathering information on those waste streams that our study indicates may meet EPA's criteria for listing as hazardous wastes requiring regulation--dump leach waste, because of its high metal concentrations and low pH, and wastes containing cyanides. Although these waste streams are potential candidates for listing as hazardous wastes, we need to gather additional information similar to the information gathered for the rulemaking for corrosive and EP toxic wastes. When we have gathered sufficient information, we will announce our decision as to whether to initiate a formal rulemaking. If the Agency finds it necessary to list any of these wastes, we will also develop appropriate management standards in the same manner as we did those developed for corrosive and EP toxic wastes.

Finally, EPA will continue to study radioactive waste and waste with the potential to form sulfuric acid. The Agency is concerned that radioactive wastes and wastes with the potential for forming acid may pose a threat to human health and the environment, but we do not have enough information to conclude that they do. We will continue to gather information to determine whether these wastes should be regulated. If EPA finds that it is necessary to regulate these wastes, the Agency will develop the appropriate measures of hazard and the appropriate waste management standards.